

What we claim is:

5 1. A gas turbine combustor capable of operating on multiple fuels with reduced carbon buildup, said combustor comprising:

 a generally cylindrical combustion liner having a center liner axis, a first end, and a second end;

10 a cap assembly fixed to said combustion liner proximate said first end and located generally within said combustion liner, said cap assembly having a plurality of openings located about said center liner axis, each of said openings having a mixing tube and a collar, with said mixing tube having a forward tube end and an
15 aft tube end with said aft tube end proximate said opening, and said collar positioned adjacent said forward tube end of said mixing tube;

 a plurality of fuel nozzles arranged about said center liner axis, each of said fuel nozzles corresponding to one of said openings, and having a fuel nozzle axis, a
20 nozzle tip, and comprising:

 a liquid fuel assembly comprising:

 a first tube extending substantially along said fuel nozzle axis;
25 a second tube surrounding said first tube;
 a third tube surrounding said second tube,

 a gas fuel assembly comprising:

30 a nozzle body surrounding said third tube of said liquid fuel assembly, said nozzle body having a first wall, a second wall, and a plurality of swirler vanes extending therebetween; and,

 wherein each of said first, second, and third tubes extend to proximate said nozzle
35 tip, said nozzle body extends to proximate said nozzle tip, and said nozzle tip is

5 located approximately halfway between said forward tube end and said aft tube
end of said mixing tube.

2. The gas turbine combustor of Claim 1 wherein a portion of said second wall of said
nozzle body is in contact with said collar of said cap assembly.

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3. The gas turbine combustor of Claim 1 wherein said nozzle body is generally conical
and tapers generally inward at said nozzle tip towards said fuel nozzle axis.

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4. The gas turbine combustor of Claim 1 wherein said mixing tube of said cap assembly
has generally conical first and second portions with said first portion converging towards
a mixing tube throat and said second portion diverging from said mixing tube throat.

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5. The gas turbine combustor of Claim 4 wherein said first portion of said mixing tube
having a plurality of first cooling holes and said second portion of said mixing tube
having a plurality of second cooling holes.

6. The gas turbine combustor of Claim 5 wherein said plurality of first cooling holes is
oriented generally perpendicular to said first portion of said mixing tube.

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7. The gas turbine combustor of Claim 5 wherein said plurality of second cooling holes is
oriented at an angle relative to said mixing tube and towards said aft tube end of said
mixing tube.

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8. The gas turbine combustor of Claim 7 wherein said angle of said second cooling holes
is between 15 and 45 degrees.

9. The gas turbine combustor of Claim 1 wherein said nozzle tip is proximate said mixing
tube throat.

- 5 10. The gas turbine combustor of Claim 1 wherein said first tube of said liquid fuel assembly contains a liquid fuel, such as No. 2 diesel fuel.
11. The gas turbine combustor of Claim 1 wherein said second tube of said liquid fuel assembly contains water.
- 10 12. The gas turbine combustor of Claim 1 wherein said third tube of said liquid fuel assembly contains compressed air.
13. The gas turbine combustor of Claim 1 wherein natural gas passes between said third tube and said nozzle body first wall and is injected into a passing flow of swirling compressed air by a plurality of gas injection holes.
- 15 14. A fuel nozzle for use in a dual fuel gas turbine combustion system, said fuel nozzle having a fuel nozzle axis, a nozzle tip, and comprising:
- 20 a liquid fuel assembly comprising:
- a first tube extending substantially along said fuel nozzle axis;
- a second tube surrounding said first tube;
- 25 a third tube surrounding said second tube;
- a gas fuel assembly comprising:
- 30 a nozzle body surrounding said third tube of said liquid fuel assembly, said nozzle body having a first wall, a second wall, and a plurality of swirler vanes extending therebetween;
- wherein each of said first, second, and third tubes extend to proximate said nozzle tip, said nozzle body extends to proximate said nozzle tip, and said nozzle tip is
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5 located at a position approximately halfway between a forward tube end and an
aft tube end of a mixing tube, such that a sufficient distance is provided for
mixing of a gaseous fuel and air while minimizing interaction between a liquid
fuel and said mixing tube.

10 15. The fuel nozzle of Claim 14 wherein said nozzle body is generally conical and tapers
generally inward at said nozzle tip towards said fuel nozzle axis.

16. The fuel nozzle of Claim 14 wherein said first tube of said liquid fuel assembly
contains a liquid fuel, such as No. 2 diesel fuel.

15 17. The fuel nozzle of Claim 14 wherein said second tube of said liquid fuel assembly
contains water.

20 18. The fuel nozzle of Claim 14 wherein said third tube of said liquid fuel assembly
contains compressed air.

19. The fuel nozzle of Claim 14 wherein gas passes between said third tube and said
nozzle body first wall and is injected into a passing flow of swirling compressed air by a
plurality of gas injection holes.

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